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QUESTIONS

ON THE

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FOR THE USE OF SEAMEN.

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QUESTIONS ON THE BAROMETER MANUAL

FOR THE USE OF SEAMEN.

THE BAROMETER, AND METHOD OF USING IT.

Description of the Instrument and Instructions for its Management.

Question. What is a Barometer?

Answer. An instrument with which to measure the variations in the pressure of the atmosphere.

Q. Explain the construction of the Barometer?

A. It consists of a glass tube closed at one end, which is filled with mercury; the tube is then inverted, and its open end immersed in a small cistern also containing mercury, taking care to prevent the air entering the tube.

Q. Why should the air be excluded?

A. Because its presence will vitiate the readings of the instrument.

Q. What is the action of the barometer?

A. The pressure of the atmosphere on the surface of the mercury in the cistern maintains the mercury in the tube at a height corresponding to that pressure.

Q. How is the pressure measured?

A. By reading the height of the column of mercury in the tube.

Q. When a Barometer is supplied to a ship from the Meteorological Office, what should first be done?

A. Its official number and all particulars relating to the instrument should be written in the Meteorological log.

Q. If the ship has also a private instrument, what information should be given in the log ?

A. Full particulars should be noted respecting this instrument, and frequent comparisons made with the Meteorological Office Barometer during each voyage.

Q. Why should these comparisons be made ?

A. So that in case of accidents to the Official Barometer means will exist for correcting observations taken with the private instrument.

Q. Why is this so necessary ?

A. Because observations taken with instruments not verified by comparison with an instrument whose error is known are almost useless for scientific purposes.

Q. What other important information should be noted in the Log about the Barometer ?

A. The height of the cistern above sea-level at the beginning of each voyage, and also if any change is made in the position of the instrument.

Q. What precautions are necessary in selecting a place for hanging the Barometer ?

A. It should hang in a convenient place for observing, with the light coming from behind the observer ; it should swing freely and be carefully protected from injury, and where it is not liable to any considerable changes of temperature, from sunshine or the direct heat of lamps or fires.

Q. Explain the process of hanging the Barometer ?

A. The bracket having been screwed up, the instrument should be carefully lifted out of the box, the hinged part of the suspension arm bent back and the Barometer slipped into the bracket.

Q. Should the screws of the bracket be driven quite home ?

A. Not until the instrument is in position.

Q. Why?

A. Because, if screwed too tight, the hinged part of the suspension arm will not slip readily into the bracket.

Q. Is the instrument ready for use immediately after fixing?

A. Usually in about an hour, but as local temperature affects the instrument slowly it is well not to record observations for some hours after.

Q. If the mercury does not descend from the top of the tube, what should be done?

A. Tap the cistern end rather sharply, increasing the force of the tap if necessary; or else make the instrument swing a little in its gymbals, but never use violence.

Q. How should a Barometer be taken down and placed in its box?

A. The vernier should be brought down to the bottom of the scale, and having lifted the instrument out of the bracket, bring it gradually into an inclined position, to allow the mercury to flow very gently to the top of the tube, and lay it in its box.

Q. Why should the mercury be allowed to flow gently to the top of the tube?

A. Because absence of air from the tube would make the force of a blow little different from that of a solid rod of metal, which might knock out the end of the tube.

Q. How should it be carried?

A. Cistern end upwards, or lying flat, and it must not be subjected to jar or concussion.

Q. How should a Barometer be packed for travelling?

A. It should be enclosed in a packing case with two or three inches of elastic packing all round it.

Q. What precautions should be taken in closing the box?

A. To avoid concussion it should not be nailed down, but fastened with screws.

Q. If several Barometers are packed together, how should they be placed in the packing case ?

A. With their cisterns at the same end, which should be marked.

Method of Reading the Barometer.

Q. What is a Vernier ?

A. A small moveable scale attached to a Barometer, and to many other scientific instruments.

Q. What is the use of the Vernier ?

A. To facilitate the taking of accurate readings of the instrument.

Q. What are the general principles of the Vernier ?

A. That a given length of the Vernier, equal to a certain number of divisions of the fixed scale of the instrument, is divided into one more or one less than that number of divisions.

Q. How are the fixed scales of English Standard Barometers divided ?

A. Into inches, tenths and half-tenths.

Q. How many divisions of the Vernier coincide with 24 of the smallest divisions of the fixed scale ?

A. 25.

Q. How much longer is a space on the scale than a space on the Vernier ?

A. By the 25th part of ·050, or ·002 of an inch.

Q. How is the Vernier moved ?

A. By a rack and pinion which ends in a milled head.

Q. How is the Vernier set ?

A. By bringing its lower edge to exactly touch the middle and uppermost point of the convex or curved surface of the mercury in the tube.

Q. What should be the position of the observer when setting the Vernier?

A. The line of sight should be at right-angles to the tube, and on a level with the top of the mercury.

Q. Should the instrument be touched while the observation is being made?

A. No.

Q. Why not?

A. Because the instrument should hang truly vertical; any inclination will cause the mercury to rise in the tube.

Q. What means may be employed to facilitate setting the Vernier accurately?

A. A piece of white paper placed behind the tube to reflect the light.

Corrections of Readings of the Barometer.

Q. What is meant by the correction for temperature?

A. The mercury in the tube of a Barometer becomes longer when heated and shorter when cooled, the allowance to be made for this is called the "correction for temperature."

Q. What is the standard temperature to which all barometric readings are by common consent reduced?

A. 32° Fahrenheit.

Q. How is the temperature ascertained?

A. By reading the Thermometer, which is fixed to the instrument.

Q. What is this Thermometer called?

A. The "Attached Thermometer."

Q. Is there any other temperature correction?

A. A similar correction is required to compensate the variations of temperature of the brass scale.

Q. How are these corrections for temperature obtained?

A. From a table of correction which has been constructed for the purpose.

Q. How is the correction applied to the readings of the instrument?

A. When the attached Thermometer is above 28° it must be subtracted, and when below 28° added.

Q. What other corrections are there?

A. Three, viz. for capillarity, capacity and altitude.

Q. Are all these corrections necessary?

A. Not for the Meteorological Office instruments, for they are so constructed as to render the corrections for capillarity and capacity unnecessary.

Q. How can you tell with non-official instruments when these two corrections should be made?

A. When such corrections are needed they are commonly engraved on the instrument.

Q. What correction besides that for temperature is usually to be applied?

A. The correction for altitude.

Q. With what object is it applied?

A. To reduce the readings of the instrument to the common standard of sea-level, the pressure of the atmosphere being reduced as the altitude of the observer is increased.

Q. What does the correction for altitude amount to?

A. About ·001 of an inch for each foot of altitude above sea-level.

Q. How is this correction applied?

A. It is always added.

Q. Should the readings of the Barometer be corrected before entering them in the register or log?

A. No.

Q. Will the readings of the Barometer on board ship agree with those on barometrical pressure charts ?

A. No, they will usually be higher.

Q. Why is this ?

A. Because the values on the charts are the mean values reduced to 32° Fahr.

BAROMETRIC PRESSURE.

Connection of Changes of Barometric Pressure with Changes of Weather.

Q. What is wind ?

A. Air in sensible motion.

Q. What causes this motion of the air ?

A. The difference in pressure of the atmosphere at different places.

Q. What is the cause of the variation in the force of the wind and changes of weather generally ?

A. The amount of the disturbances of pressure, and the rapidity with which those disturbances take place.

Q. Does the Barometer furnish the seaman with the means of knowing when these disturbances will take place ?

A. Yes, with considerable certainty.

Q. Will consecutive readings of the Barometer taken at equal intervals of time exactly coincide with one another ?

A. Very rarely.

Q. How often should the Barometer be set and read ?

A. At regular intervals, if possible every four hours, and in doubtful weather oftener, recording the readings in the log.

Q. Why should the readings be recorded in the log?

A. Because it will then be known when the instrument was last set, and if any change has taken place.

Q. How may the changes of pressure be classified?

A. As regular or irregular in their occurrence, in other words, periodical or non-periodical.

Q. Which are the periodical changes?

A. Those depending on the time of day or year.

Q. Which are the non-periodical changes?

A. Those depending on the changes of weather.

Influence of Temperature on Barometric Pressure.

Q. On what do the changes of pressure mainly depend?

A. On changes of temperature.

Q. What is the effect of air being heated?

A. It expands.

Q. What is the effect of air being cooled?

A. It contracts.

Q. What results from any place being more heated than its neighbourhood?

A. The air over it expands, and the higher strata flow away from it over the less heated areas.

Q. What results from any place being colder than its neighbourhood?

A. The air over it contracts, and the upper strata of air flow in towards it from the more heated areas.

Q. How is pressure affected by the air flowing away from any place?

A. It is reduced.

Q. How is pressure affected by the air flowing towards any place ?

A. It is increased.

Q. What are isobaric lines or isobars ?

A. The lines drawn on Charts over places having equal Barometric pressure.

Q. At what time of the year is the Barometer higher over the land than over the sea ?

A. In the winter.

Q. Why is this ?

A. Because the land at that season is colder than the sea.

Q. At what time of the year is the Barometer lower over the land than over the sea ?

A. In summer.

Q. Why ?

A. Because the land at that season is hotter than the sea.

Q. In what part of the world do we find Barometrical Pressure comparatively low ?

A. In the Tropics.

Q. Why ?

A. Because the temperature is high in those regions.

Q. What is the origin of permanent and periodical winds ?

A. The variations in pressure over the sea and land.

Q. What are these winds called ?

A. Trade Winds and Monsoons.

Distribution of Mean Barometric Pressure.

Q. The Pressure Charts in the Barometer Manual are for the months of January and July—Why have these months been selected ?

A. Because the pressure in those months differs in opposite directions most widely from the mean of the year.

Q. What do these Charts show?

A. That the pressure over the sea is more uniform than over the land.

Q. In respect to Barometrical Pressure, how may the sea be divided?

A. Into five great areas.

Q. Name them?

A. (1) A belt of moderately low pressure over the Tropics.
(2) Two belts of high pressure north and south of the Tropics.
(2) Two belts of low and diminishing pressure in the higher latitudes forming a complete circuit of the Globe in both hemispheres.

Q. What is the average height of the Barometer at sea-level in England?

A. Rather less than 30 inches.

Q. Within what limits does the height vary?

A. The mercury sometimes rises to nearly 31 inches, and falls below 28.

Q. What is the height of the Barometer on the parallel of Cape Horn?

A. About 29·50 inches throughout the year.

Q. How much lower is this than the generally prevailing pressure over the navigable oceans?

A. Fully half an inch.

Q. What is the average height of the Barometer in the Tropics?

A. About 30 inches.

Q. In what parts of the ocean are the highest readings?

A. The central parts—in the Temperate Zones.

Q. What are the highest readings in those regions?

A. 30·2 inches, extending over large areas.

Q. What is the mean height of the Barometer in the British Islands in Mid-Winter?

A. It ranges from 29·65 to 29·95 inches in ordinary weather.

Q. What is its mean height in Mid-Summer?

A. It ranges from 29·80 to 30·00 inches.

Q. On a voyage, made at any period of the year, from England to Australia, *viâ* the Cape, and returning *viâ* Cape Horn, what variation in the readings of the Barometer may you expect to experience in ordinary weather?

A. About $\frac{7}{10}$ of an inch.

Q. On a voyage to China, *viâ* the Canal, what changes may be expected in ordinary weather in Mid-Summer?

A. About $\frac{4}{10}$ of an inch.

Q. What is meant by the terms "high" and "low" Barometer?

A. When the readings of the instrument are above or below the average.

VARIATION OF PRESSURE.

Periodical Variations of Pressure.

Q. What is the diurnal variation of pressure?

A. The variation which takes place daily.

Q. In what part of the world is it most regular?

A. In the Tropics.

Q. How many oscillations are there in the diurnal variation of pressure?

A. Two periods of rising Barometer and two of falling.

Q. What are the times of rising Barometer?

A. From 4 a.m. to 10 a.m., and from 4 p.m. to 10 p.m.

Q. What are the times of falling Barometer?

A. From 10 a.m. to 4 p.m., and from 10 p.m. to 4 a.m.

Q. Of the two maximum levels which is the highest?

A. The morning maximum is usually the higher.

Q. At what time does the morning maximum occur?

A. Usually rather before 10 a.m.

Q. At what time does the night maximum occur?

A. Usually rather after 10 p.m.

Q. Of the two minimum oscillations which is the highest?

A. With few exceptions the morning.

Q. At what time does the lowest minimum occur?

A. Rather after 4 p.m.

Q. Where over the ocean does the diurnal range attain its greatest magnitude?

A. In the Tropics, and it gradually diminishes in higher latitudes.

Q. Is it observed in the Arctic and Antarctic regions?

A. It is hardly perceptible.

Q. On what phenomenon is this daily oscillation of the mercury mainly dependent?

A. The range of daily temperature.

Q. What influences the times of maxima and minima?

A. The times of sunrise and sunset.

Q. In the Tropics is the diurnal range over the ocean the same throughout the year?

A. Yes.

Q. Why is this?

A. Because the range of temperature and the length of the days do not alter to any great extent.

Q. On land and beyond the Tropics do the diurnal variations of pressure occur with the same regularity?

A. No, they fluctuate both in amount and period.

Q. What is the daily range of the Barometer in Tropical seas?

A. *·07 or ·08 of* an inch.

Q. What is the amount of diurnal range at Calcutta ?

A. About ·14 of an inch in April and May, when the range of temperature is greatest, and ·09 of an inch in July, when it is least.

Q. Is diurnal range observable in the British Islands ?

A. Very rarely on the readings of one day, but it is quite apparent when the observations extend over such a period as a month.

Q. What does it amount to ?

A. About ·02 of an inch.

Q. Why is the observation of the diurnal range of so much importance to the sailor in the Tropics ?

A. Because any marked deviation in the diurnal range will warn him of a change of weather, possibly of a hurricane.

Q. At what times, in Tropical seas, does the mean pressure occur ?

A. Between noon and 1 p.m., and between 6 a.m. and 7 a.m.

Non-periodical Variations of Pressure.

Q. Within the Tropics what is the ordinary amount of fluctuation in barometric pressure ?

A. Including the diurnal range it seldom exceeds 3 or 4 tenths of an inch.

Q. What would it amount to in a hurricane ?

A. In the dangerous part of the storm-field two inches or more.

Q. Does the range increase with the latitude ?

A. Yes, to some extent.

Q. In what latitude does it reach its maximum ?

A. Between the 60th and 65th parallels, gradually diminishing towards the Poles.

Q. What is the average range of the Barometer in the British Islands in the month of January?

A. About 1·7 inches.

Q. What is it in the month of July?

A. About $\frac{9}{10}$ of an inch.

Q. What is the average height of the Barometer in the English Channel?

A. 29·95 inches.

Q. Are the fluctuations greater in Winter or in Summer?

A. In Winter.

Q. What are the highest and lowest readings that may be ordinarily experienced in that season?

A. 30·50 and 29·00 inches.

Q. What is the average height of the Barometer off Cape Horn?

A. 29·50 inches.

Q. What are the average highest and lowest readings that may be experienced in the Winter, off Cape Horn?

A. 30·15 and 28·40 inches.

Q. What are the uses of Isobaric Charts to the seaman?

A. With the aid of such Charts, and the range, he is able to estimate what the probable readings of his own Barometer should be.

Winds, their Causes and Distribution.

Causes which determine the Force and Direction of the Wind.

Q. On what does the direction and force of wind mainly depend?

A. On the barometrical gradient.

Q. What is the barometrical gradient?

A. The difference in pressure expressed in hundredths of an inch over a given distance.

Q. What distance has been universally adopted?

A. 15 miles.

Q. What is meant by gradients being steep?

A. When the difference of pressure is great.

Q. What results when the gradients between two places are steep?

A. The isobars will be close together and the winds strong.

Q. Is the air which surrounds the surface of the Earth at rest?

A. Apparently so, but in reality it is moving with great velocity from West to East with the Earth as it revolves on its axis.

Q. Where is this velocity the greatest?

A. At the Equator, and diminishes as the Poles are approached.

Q. What is the velocity at the Equator?

A. About 1,000 miles an hour.

Q. When does this motion of the air become effective?

A. When it is impelled to a latitude having either a higher or lower velocity.

Q. In the Northern Hemisphere, what winds are produced by a current of air setting from a lower to a higher latitude?

A. South-westerly.

Q. In the northern hemisphere what winds are produced by a current of air setting from a higher to a lower latitude?

A. North-easterly.

Q. How does the wind circulate round areas of low pressure in the Northern Hemisphere?

A. Against watch hands.

Q. How does the wind circulate round areas of high pressure in the Northern Hemisphere?

A. With watch hands.

Q. Are these two facts true in the Southern Hemisphere?

A. The converse is true in both cases.

Q. What are those winds called which circulate round areas of low pressure?

A. Cyclonic.

Q. What are those winds called which circulate round areas of high pressure?

A. Anti-Cyclonic.

Q. What is meant by indraught?

A. That the winds do not blow exactly along the isobars of cyclonic systems, but are inclined towards the centres of the systems at a certain angle.

Q. What is the probable value of this angle?

A. About 20°.

Q. State Buys Ballot's law for the Northern Hemisphere?

A. Stand with your back to the wind and the Barometer will be lower on your left hand than on your right.

Q. State Buys Ballot's law for the Southern Hemisphere?

A. Stand with your back to the wind and the Barometer will be lower on your right hand than on your left.

Prevailing Winds at various Seasons over different parts of the Globe.

Q. What are the two general laws which govern the prevailing winds of the globe?

A. The greater heat of the Continents in relation to the sea during summer, and their greater relative cold in winter.

Q. What is the motion of the air currents in the Atlantic and Pacific oceans?

A. The air pours out of the Northern and Southern belts of high pressure into the equatorial belt of low pressure.

Q. What is the direction of the winds on the Polar sides of the belts of high pressure?

A. Westerly.

Q. To what cause may the variations in the winds around the Continents be attributed?

A. To seasonal changes, and to the extent and shape of the areas of high and low pressure over the land in winter and summer respectively.

Q. What are the prevailing winds over Canada in winter?

A. North-westerly.

Q. How far does this North-westerly current of air extend?

A. From the Mississippi to Davis's Straits—nearly.

Q. What is the direction of the wind over the western portion of the North Atlantic in winter?

A. Westerly.

Q. From the Azores towards Siberia, what is the prevailing wind in winter?

A. South-westerly.

Q. How far does the area of low pressure which lies to the Southward of Iceland in winter extend?

A. North-westward to Baffin's Bay, and North-eastward over the Arctic Sea.

Q. What is the cause of the Northerly and North-easterly winds which prevail in the high latitudes of the Atlantic and Polar Seas during the winter?

A. The relatively high pressure area lying over Greenland.

Q. In the Winter do we find in the North Pacific an area of low pressure similar to that in the North Atlantic?

A. Yes, but it does not extend so far North.

Q. What winds are experienced over the Eastern portion of the Continent of Asia at this season?

A. North-westerly.

Q. What are the prevailing winds between Behring Straits and Vancouver Island?

A. South-easterly.

Q. In the winter are there any other areas of high pressure in the Northern Hemisphere besides that lying over Greenland?

A. One over North America, and a larger and more remarkable one covers nearly the whole of Asia.

Q. What winds are experienced from the Equator to 30° North latitude?

A. North-easterly winds predominate round the greater portion of the globe.

Q. During Summer in the Southern Hemisphere, where are the areas of low pressure situated?

A. Over the interior of South America, the Southern part of Africa and the Continent of Australia.

Q. South of latitude 40° S., what are the prevailing winds?

A. Westerly and North-westerly winds predominate round the globe.

Q. What is the name which Sailors give to this region?

A. The "Roaring Forties."

Q. In the Spring of the Northern Hemisphere, is the distribution of mean pressure the same as in Winter?

A. No.

Q. Where is the change observed?

A. Over the interior of the Continents, where the Barometer falls briskly.

Q. Where is it the least marked?

A. In the Oceanic districts of the high pressure belt.

Q. Where is it the greatest?

A. Over the Southern part of Asia.

Q. Are there any other changes of pressure in the Northern Hemisphere during spring?

A. A temporary increase takes place in the high latitudes.

Q. Is the weather in England affected by these changes in the distribution of pressure?

A. The North-easterly winds we experience in the early Spring may be attributed to them.

Q. In the Southern Autumn does any change take place in barometrical pressure?

A. It is increased over the Southern portion of South America, South Africa and Australia.

Q. In the Summer of the Northern Hemisphere, where are the areas of low pressure situated?

A. Over the interior of North America, North Africa, and a very large area over central Asia.

Q. What winds are experienced over Eastern Europe at this season?

A. North-westerly.

Q. What winds are experienced over the Mediterranean?

A. Northerly.

Q. What are the prevailing winds in lower North Latitudes?

A. South-westerly.

Q. Does any change take place in the Southern Hemisphere during the Northern Summer?

A. The high pressure belt becomes well marked and extends round the globe.

Q. What are the changes which take place over the British Islands in Autumn?

A. The reverse of those which occur during the Spring.

Winds and Storms of the Temperate Zones.

Q. What is the constant feature of barometric pressure in the North Atlantic?

A. A large area of high pressure situated between the parallels 30° and 40° N.

Q. How does this affect the wind?

A. By Buys Ballot's law—

The wind is	North	on the	East	of that area.
	East	,,	South	
	South	,,	West	
	West	,,	North	

Q. What winds will a captain meet on his route to the Cape, before he reaches the Equator?

A. As he approaches the coast of Portugal, the wind draws to North-west, then gradually shifts to North and North-east as he proceeds to the Southward.

Q. Why does he meet these changes?

A. He passes from the North-east to the East and South-east sides of the area of high pressure.

Q. What are the experiences of a homeward-bounder when North of the Equator?

A. At the Northern edge of the North-east Trade the wind grows Easterly, and falls light with a rising barometer.

Q. What is this region of light winds and high barometer called?

A. The Calms of Cancer.

Q. Why is there no wind in the Calms of Cancer?

A. There is no difference of pressure.

Q. If the ship meets a shift of wind from North-east to South-east, South, and South-west, what has been her route?

A. She has passed round the South-west, West, and North-west sides of the area of high pressure.

Q. What are the experiences of a captain in the South Atlantic, leaving the Cape?

A. He meets South-west winds shifting to South, and South-east.

Q. Why does he meet these changes?

A. He passes along the South-east, East, and North-east sides of the area of high pressure.

Q. What changes does a captain outward-bound in the South Atlantic meet?

A. The wind shifts from North-east to North, and North-west.

Q. Why does he meet these changes?

A. He is passing on the North-west, West, and South-west sides of an area of high pressure in the Southern Hemisphere.

Cyclonic Gales of the Temperate Zones.

Q. What conditions regulate the general character of the weather of the Temperate Zones?

A. The permanent areas of high and low pressure, and the subsidiary travelling areas of low pressure.

Q. How do these areas move?

A. Almost always Easterly with the prevailing wind.

Q. What is their character in the Northern Hemisphere.

A. The wind in them begins at South, and shifts to West and North-west.

Q. Is their circulation complete?

A. No; they have little East wind.

Q. Why is the East wind absent?

A. The pressure to the North is so low that no gradient for East winds can be formed.

Q. Describe the gales of the Southern Hemisphere?

A. They begin with a North wind, which goes through West to South-west, with little East wind.

Q. Why is the East wind absent?

A. There is a permanent depression near the South Pole, so that no gradients for East winds can be formed.

Q. When may a shift of wind from South-east to South be not a dangerous sign in the Northern Hemisphere?

A. When an area of high pressure passes to the Eastward.

Q. What signs should therefore be looked to?

A. The behaviour of the barometer.

Q. What is the difficulty for a seaman in telling what sort of weather he will have?

A. He cannot tell what changes are going on in other parts of the sea.

Q. Do gales only come with a fall of the barometer?

A. No; very heavy gales come with a sudden rise of the barometer.

Q. How do the cyclonic gales of the Temperate Zone differ from Tropical cyclones?

A. They have seldom a true central calm with winds from opposite directions on both sides.

Q. Why should the captain learn on which tack he should lie-to?

A. Because the storm may resemble a hurricane.

Q. What is the most dangerous feature of these storms?

A. The sudden shift of wind from South-west to North-west in the Northern Hemisphere, and from North-west to South-west in the Southern Hemisphere.

Q. What accompanies this shift?

A. Heavy rain or hail, with thunder and lightning, and a sudden fall of the thermometer.

Q. What two points are of interest to the seaman in these storms?

A. I. The barometer changes according to tack. II. The motion of the storm.

Q. How does the barometer behave on board ship according to the tack?

A. *It rises* on the starboard and falls on the port tack in the *Northern Hemisphere*; rises on the port and falls on the starboard *Southern Hemisphere.*

Q. How is this explained ?

A. By Buys Ballot's law, the lowest barometer is on your left hand when you are before the wind in the Northern Hemisphere.

Q. Why does the barometer rise on the starboard tack ?

A. Because the ship goes from a lower to a higher barometer.

Q. Is this rule always applicable ?

A. No; for the high pressure may be receding from the ship faster than she sails, or a low pressure may be coming up astern.

Q. If a low pressure moves away faster than the ship sails, what will happen ?

A. Though on the port tack the barometer will not fall.

Q. Why is a rising barometer on the starboard tack not necessarily a good sign when in the Northern Hemisphere ?

A. Because that is the ordinary behaviour of the instrument.

Q. What is the best sign given by the barometer ?

A. A rising barometer on the port tack.

Q. What is the worst sign given by the barometer ?

A. A falling barometer on the starboard tack.

Q. How does the fact of the motion of a storm affect the seaman ?

A. If he is steaming ten miles an hour, and the storm is advancing twenty miles an hour; if he meets it, its relative motion to him is thirty miles; if he runs with it, ten miles an hour.

Q. How will this motion affect his observations ?

A. If the storm meets him, his barometer will fall more rapidly and his wind shift more quickly than in the other case.

Q. If you plot a vessel's observations on a diagram, how can you tell which way she is sailing ?

A. Going Westwards the curves will be much more irregular than going Eastwards.

Q. What are the usual signs of a Westward voyage in a steamer crossing the North Atlantic ?

A. The barometer falling with a South-east or South wind, and rising with a West and North-west wind.

Q. What are the usual signs of an Eastward voyage in a steamer ?

A. If she steams faster than the storm moves, the barometer may rise with a South-east or South wind, and fall with a North wind.

Q. What does the fall of the barometer with a North wind indicate ?

A. That the ship has entered the Western side of another wind system.

Gales of the North Temperate Zone.

Q. How does a gale begin in the North Temperate Zone ?

A. With a South or South-easterly wind, a high temperature, and falling barometer.

Q. What will be the action of the Barometer ?

A. The barometer will fall till the wind shifts to the Westward in a heavy shower, when it will rise again.

Q. Is the rate of fall of the barometer an indication of the probable strength of the gale ?

A. Not a certain indication, for the rate of fall depends partly on the rate of motion of the storm.

Q. When will the barometer cease falling when the gradients are steep and the wind blows hard ?

A. If the storm is stationary.

Q. If a storm is stationary, what will make the barometer fall ?

A. The depression becoming deeper.

Q. When might a rapid fall of the barometer be accompanied with light winds?

A. When a depression with slight gradients is travelling rapidly.

Q. If a ship is homeward bound, what will she experience?

A. She may fall in with a South wind and falling barometer.

Q. If the barometer is steady with a South wind in a homeward-bound ship, what does it indicate?

A. That she is keeping pace with a storm coming from the West.

Q. If the captain has to heave-to to wait for a pilot or for daylight, what should he do?

A. Make snug, as he allows time for a depression to overtake him.

Q. What is the general behaviour of the Barometer with a South wind in North latitude?

A. If sailing Westward, the barometer will fall faster than if hove-to or running Eastward.

Q. How can a ship make best way Westwards if the wind is South and barometer falling?

A. Stand Northwards so as to make the wind back to the East.

Q. Why is it uncertain whether you can get less wind by running Northwards?

A. Because the extent in area of these storms is not fully known.

Q. What should a weak ship do if the South wind got strong?

A. Lie-to on the starboard tack, as the "coming-up" tack.

Q. In a strong ship what may be done?

A. Keep on the port tack till the wind shifts to the Westward, and then tack to the South-west.

Q. What is the danger of this course?

A. She may be caught aback as the wind shifts, and will be in the trough of the sea.

Q. If you are on the starboard tack what may you expect?

A. That you will leave the depression, but, perhaps, sail into the Southerly wind of another.

Gales of the South Temperate Zone.

Q. What are the experiences of a ship running to Australia in South latitude?

A. She experiences gales beginning at North and North-east, and passing generally through North-west to South-west.

TROPICAL STORMS.

Hurricanes, Typhoons, or Cyclones of Tropical Seas.

Q. What are the most serious atmospheric disturbances?

A. The Revolving storms of the Tropics.

Q. By what names are these known?

A. Hurricanes in the West Indies; Typhoons in the China Sea; and Cyclones in the Indian Ocean.

Q. What parts of the Ocean are free from them?

A. Within 5° or 6° of the Equator, and in very high latitudes.

Q. Where are they most frequent and most severe?

A. The West Indies, vicinity of Mauritius, Bay of Bengal, and China Seas.

Q. In the West Indies and China Seas at what periods are they most frequent and most severe?

A. The months following the summer solstice in each hemisphere—that is, July—October in the North,
December—April in the South.

Q. When in the Arabian Sea and Bay of Bengal?

A. April to June, October and November.

Q. What motions has the air in a cyclone?

A. A motion round a centre, and an onward movement.

Q. Of what character is the motion round the centre?

A. More or less circular.

Q. What is the character of the path of the storm field?

A. Either straight or curved.

Q. Is its velocity uniform?

A. No, sometimes it is very great, sometimes the storm appears to pause or advance very slowly.

Q. Is the area of the storm uniform?

A. No, sometimes it is only 20 or 30 miles in diameter, sometimes hundreds of miles in diameter.

Q. Is the force of the wind constant?

A. No, it is ever varying, at times lulling to a strong breeze, and then rising to a very violent blast.

Q. When is the blast most violent?

A. When the centre is approached.

Q. What is the invariable characteristic of these storms?

A. That they gyrate in one direction in each hemisphere; against the hands of a watch in the Northern, with the hands of a watch in the Southern.

Q. For what two reasons is the knowledge of this law important?

A. It enables the seaman to distinguish between these gales and those in which the direction of the wind varies little, and it reveals to him the position of the centre of the storm.

Q. Why is the knowledge of the position of the centre of the storm valuable?

A. Because there the force of the wind is greatest, its changes of direction most sudden, and the sea most dangerous.

Q. How are these storms formed?

A. A central area of low pressure is produced, by some local atmospheric disturbance, and the surrounding air is drawn in from all sides.

Q. Describe the usual track of these storms in the North Atlantic or South Indian Ocean?

A. For some days they travel along a path not exactly West, but inclining toward the pole of the hemisphere which they are crossing; about lat. 25° they curve still more and move North-east in the Northern, South-east in the Southern Hemisphere.

Q. Where do the cyclones of the Bay of Bengal originate?

A. Near the Andaman Islands.

Q. Where those of the Arabian Sea?

A. Near the Laccadives.

Q. How do these travel?

A. To the Westward and North-west.

Q. How do the Typhoons of the China Seas move?

A. Commonly Westerly or North-westerly.

Q. What is the rate of motion of cyclones?

A. Variable, from 50 to 300 miles a day.

Q. What in West Indies?

A. 300 miles a day.

Q. What in the Arabian Sea, Bay of Bengal, and China Sea?

A. 200 miles a day.

Q. What in the South Indian Ocean?

A. It varies from 50 to 200 miles a day.

Q. What are the indications of the approach of a revolving storm?

A. The usual ugly and threatening appearance of the weather which forbodes most storms, and the increasing number and severity of the gusts with the rising of the wind, sometimes preceded by a heavy and confused sea from the direction in which the storm is *approaching.*

Q. Why does the sea precede these storms ?

A. Because it travels more rapidly than the storm-centre.

Q. What is the surest sign of the approach of a storm ?

A. Great barometrical disturbance.

Q. What do you mean by disturbance ?

A. The barometer at the centres of some storms stands fully 2 ins. lower than outside the storm field.

Q. What signs does the barometer give of the approach of a storm ?

A. If it falls rapidly, or even if the regularity of its daily variation is interrupted.

Q. How low does the barometer fall ?

A. Often below 28 ins.

Q. Is the fall very sudden ?

A. As much as 1·7 ins. in seventy minutes has been noticed.

Q. What is the average gradient near the vortex ?

A. One inch in 50 nautical miles.

Q. How do you know that you are approaching the centre ?

A. The changes of wind become more rapid.

Q. If the wind does not change, but increases in violence, and the barometer continues falling, what does it indicate ?

A. That the ship is upon the direct line of advance of the storm.

Q. What happens when the centre passes ?

A. The wind flies round at once to the opposite point.

Q. Is there any other phenomenon connected with the vortex ?

A. The wind sometimes drops entirely, and the clouds disperse for a short interval.

Q. Why should the vortex be avoided ?

A. Because ships usually lose masts or rudder in passing through it.

Q. How do you find out the bearing of the centre?

A. Take 8 points from the direction of the wind to the right in the Northern, and to the left in the Southern Hemisphere, that will be the approximate bearing.

Q. Is the wind's motion truly circular?

A. Not strictly, there is frequently some indraught in some part of the storm field.

Q. Does this indraught affect the eight point rule?

A. Before the barometer has fallen much, the centre may bear ten or twelve points from the direction of the wind.

Q. When may you take the motion to be circular?

A. When the barometer has fallen five or six tenths.

Q. If you know the bearing of the centre, what are the next points to be ascertained?

A. Which side of the storm's path the ship is on, and how the storm is moving.

Q. How do you ascertain that?

A. By the direction in which the wind shifts. In both hemispheres it is with watch hands on the right-hand side, and against them on the left, looking in the direction to which the storm is travelling.

Q. State the shifts of wind with watch hands in the Northern Hemisphere?

A. North-east, East, South-east, South.

Q. State the shifts of winds against watch hands in the Northern Hemisphere?

A. North, North-West and West.

Q. Are the shifts of wind the same in the Southern Hemisphere?

A. Yes, but in opposite directions in both cases.

Q. How is the shift calculated?

A. As it would be felt by a vessel lying-to.

Q. Why is it necessary to state this?

A. Because if the ship is moving faster than the storm and with it, the shift may be reversed.

Q. How does the wind blow on the two sides of the storm with reference to its path?

A. The wind blows towards the path on one side, and away from it on the other.

Q. How does that affect the seaman?

A. If running before the wind, he may be brought in the one case to cross the path in front of the centre—the most dangerous position. In the other case he crosses behind the centre.

Q. What is the dangerous semicircle?

A. That in which the wind blows towards the path of the storm.

Q. Why is that semicircle dangerous?

A. Because the wind in it blows towards the path.

Q. Which is the dangerous semicircle?

A. The right hand in the Northern, the left hand in the Southern Hemisphere.

Q. How are right hand and left hand taken?

A. Looking in the direction of motion of the storm.

Q. How does the wind shift?

A. It veers in the right hand, backs in the left hand semicircle.

Q. How then do you know the dangerous semicircle?

A. It is that with veering winds in Northern, with backing in Southern Hemisphere.

Q. Is there any other reason why that semicircle should be called dangerous?

A. The recurvature of the path always takes place towards it.

Q. How does the recurvature take place?

A. To the right in the Northern, to the left in the Southern Hemisphere.

Q. What are the most dangerous winds?

A. Those which are in front of the advancing centre.

Q. How do these vary?

A. They vary as the path varies.

Q. Which are the most dangerous winds in each latitude?

A. The most dangerous winds are—

Northern Hemisphere.	From the Equator to 30° N.	North-east.
	About 30° N.	East.
	Northward of 30° N.	South-east.
Southern Hemisphere.	From the Equator to 26° S.	South-east.
	About 26° S.	East.
	Southward of 26° S.	North-east.

Q. Can you determine the distance of the centre exactly?

A. Not very exactly.

Q. Why not?

A. The bearing of the centre is not accurately known, and you do not know if the storm is of large or small dimensions.

Q. What general principles are there for determining the size of a storm or distance of the centre?

A. If the barometer falls slowly and the weather only gets gradually worse, the centre is probably distant. If the barometer falls quickly, the centre is probably near.

Practical Rules for Seamen in Tropical Cyclones.

Q. What is the most important precaution in regions subject to these storms?

A. To constantly and carefully observe and record the barometer.

Q. If there are any signs of a cyclone what should be done?

A. Lie-to, and watch the changes of wind and barometer.

Q. How will this help you ?

A. It will indicate the bearing of the centre, and the shifting of the wind will show in which semicircle you are.

Q. What are the rules about lying-to ?

A. Northern Hemisphere. In the right hand semicircle lie-to on starboard tack ; in left hand run with wind on starboard quarter ; if that takes you out of your course and the barometer is rising, the centre being past, lie-to on port tack.

Southern Hemisphere. In left hand semicircle lie-to on port tack; in right hand, run with wind on port quarter, but lie-to on starboard tack.

Q. If the ship is in the direct path of the centre, what should be done ?

A. Run, but in all cases act so as to increase the distance from the centre.

Q. What are the rules for the lying-to tack ?

A. Starboard tack in both hemispheres in the right hand semicircle. Port tack in the left hand.

Q. Which is the lying-to tack for the dangerous semicircle in each ?

A. Starboard in Northern, Port in Southern Hemisphere.

Q. What phenomena show that you are receding from the centre ?

A. The Barometer rising, and wind and sea subsiding.

Q. Can you ever sail out of the dangerous semicircle across the front of the storm ?

A. Yes, if the storm is moving very slowly.

Q. Why is this risky ?

A. Because the rate of advance is uncertain.

Q. What is the most important point to observe before attempting to cross ?

A. The rate of fall of the Barometer.

Q. Why is it hard to recognise cyclones in the Indian Ocean?

A. Because a vessel entering them on the Southern side meets a strong South-easterly Trade.

Q. How can you tell whether this strong South-east wind is only the true Trade, or forms part of a Storm Circle?

A. If the wind shifts to East or South and the barometer falls rapidly, the wind probably belongs to a Storm System.

Q. What should you do if you find the South-east Trade increasing?

A. Lie-to, and watch the wind and barometer.

Q. If the wind shift from South-east towards South what should be done?

A. Run to the North-west.

Q. If the wind remains steady at South-east, and increases, the Barometer falling what should be done?

A. You are on the line of the centre. Run to the North-west.

Q. What peculiarity is there in the East and North-east winds in Indian Ocean cyclones?

A. They blow towards the centre.

Q. If you have an East or North-east wind in an Indian Ocean cyclone, what should be done?

A. Make as much easting as possible.

Q. Why do homeward-bound ships frequently come to grief in Mauritius cyclones?

A. Because they enter them on the North side with a North-east wind, which is fair, and it blows towards the centre.

Q. What warning have such ships?

A. The fall of the barometer and the threatening appearance of the weather.